

Chapter 6 : Distribution of Multiple Video and Audio Services

Distribution requirements for AFRTS Radio and Television service have changed dramatically with the implementation of the PowerVu digital compression system, which provides multiple channels of TV and audio. B-MAC delivered one video service over (SATNET) and a limited number of audio services. Most AFRTS networks distributed one channel of AFRTS Television over-the-air through VHF or UHF transmitters or as a single channel over cable systems, and radio was broadcast over one or two FM and AM transmitters. Although these delivery systems are still in use today, there is a growing demand to deliver as many of the expanded services now available over SATNET and DTS to the audience as possible. This chapter addresses the three major types of multi-channel delivery systems: CATV, MMDS, and Hybrid Satellite/Off-Air reception systems.

The most commonly used multi-channel delivery method for both AFRTS TV and radio services is cable distribution. If sufficient cable bandwidth is available an expanded or medium to large cable system can be used to deliver both TV and FM radio services

Another method for delivery of multi-channel service is Microwave Multi-point Distribution System or MMDS. MMDS is an effective method of delivering multi-channel AFRTS service to authorized audience members who do not live on Military Compounds and are not served by a cable system; however it requires host nation frequency approval. In most cases AFRTS requires MMDS systems to be encrypted. MMDS systems currently in use in Riyadh, Saudi Arabia use Zenith, (Z-TAC) and MacroVision addressable encryption systems, respectively.

A third method of receiving multiple AFRTS services is through the use of a combination of off-air and direct satellite reception. This method is especially viable in Europe where the service can be received off Hotbirds 6 and 7a using a 80cm Ku TVRO.

I. DOD CATV Performance Specifications and Testing Procedures

Overview. This chapter describes DOD operated CATV systems, establishes performance standards for these systems, and promulgates standard testing procedures. This chapter may also be of use in monitoring commercial CATV systems serving DOD audiences. In the case of Commercial CATV systems, FCC regulations, Federal or Host Country law may affect the degree of regulation allowed. (Note: In the event that Host Country regulations are more stringent than DOD Specifications, Host Country regulations shall take precedence.)

a. Assumptions regarding DOD Cable Systems:

- All CATV systems utilize broadband coaxial cable technology;

- Tree and branch, or hub and spoke architecture is used;
- Systems carry NTSC television signals;
- Systems may carry FM Audio signals;
- Systems are used to carry entertainment and informational programs. No secure or classified material is carried.

b. System Characteristics:

- Forward Bandwidth:
- Minimum 54-220 MHz {300 MHz}
- Maximum 54-450 MHz {750 MHz}

2. Reverse Bandwidth:

- Minimum 5-30 MHz; May not be active in some systems

Table 6-1 Downstream Channel Capacity		
Frequency Band	Frequency Range (MHz)	Number of Available Channels
LO VHF	54-88	5
FM	88-108	--
FM Mid Band	120-174	9
Hi VHF	174-216	7
Super Band	216-300	14
Hyper Band	300-450 (750)	25 (75)
Totals		60 (110)

Table 6-2 Upstream channel capacity		
Frequency Band	Frequency Range (MHz)	Number of Available Channels
Sub Low*	5-30	4
*Also known as "T" channels; T-7 through T-10		

II. Discussion

CATV is a closed circuit communications system used to deliver television and audio signals. It delivers these to a select group of viewers-a military base, an individual building, an individual ship, or an individual room/compartments. Other types of signals can be carried on a CATV system such as data, telemetry, or

video conferencing. However, the primary purposes of the systems discussed here are information and entertainment. They are **not** appropriate for the transmission of signals containing sensitive or classified information.

a. Authorization

Since CATV is a closed system, it is allowed to use frequencies that have been previously authorized for over the air broadcasts. The most obvious of these are the over the air VHF television and FM radio frequencies. More critical are frequencies in the ranges of 108-137 MHz, 140-174 MHz, and 225-400 MHz. Commercial and governmental air and sea navigation, air traffic control, harbor navigation, and the U.S. Coast Guard may use these frequencies.

b. Signal Leakage

CATV is a secondary user of these frequencies, and is responsible for insuring that its use does not interfere with the primary user. This interference arises from signals leaking out of the CATV system. Signal leakage, or radiation, occurs when the physical or electrical integrity of the CATV system is compromised. This can occur due to cracked cables, haphazard connections, vandalism or unauthorized connections to the system. In CONUS, the FCC can levy fines on "leaky" systems, or force them to abandon certain frequencies. The FCC has not been reluctant to exercise this power. (In reviewing this area, the FCC has established a figure of merit called a "Cumulative Leakage Index" which accumulates all leakage data into one measure.) DOD CATV systems must be especially aware of signal leakage requirements due to the proximity of over the air users. DOD CATV must take all steps necessary to insure that its signals do not interfere with other frequency users.

c. Signal Quality

Perceived signal quality at any location can be simplified to consist of two major factors: first signal strength, and second signal quality. Signal strength is a simple measurement, but signal quality is a more complex issue. If the wrong value of tap has been used at a location, the signal delivered to the television may be too weak to deliver a good picture. Similarly, if too much drop cable is used, excessive attenuation could be introduced, dropping levels to an unacceptable level. In situations like these, using different components can allow sufficient signal levels to be delivered. If this has been tried with limited success, additional amplification may be needed. This amplification must be placed at the proper location in the system if any benefits are expected. Signals must be amplified before levels have dropped so far that quality is affected. CATV amplifiers cannot improve signal quality; they can only amplify signal levels. A noisy signal, amplified, is not going to be a better signal. It is going to be a more powerful, noisy signal. The key is to amplify the signal when the relative level of the signal is well in excess of the level of noise and any other distortions. CATV amplifiers themselves, add noise and distortion to the signals, a fact that the system designer must take into account.

Table 6-3 Performance Standards for Acceptable CATV Operations

Standard	Requirement
Signal levels at subscriber set	3-10 dBmV
Carrier levels	
Single channel video vs. audio levels	Audio carrier shall be 15 dBmV +/- 2 dB below associated video carrier
Single channel video carrier	Shall vary no more than 12 dB in any 24 hour period
Adjacent channels	Video carriers will be within 3 dB of any adjacent channel video carriers
All channels	Video levels will be maintained so that the maximum difference across all channels will be 10 db for systems up to 300 Mhz, with 1 db allowed for each additional 100 MHz, or portion; i.e. 300 – 400 MHz would allow 11 db maximum variation.

Distribution System Performance

Carrier to Noise (C/N)	Any channel, greater than or equal to 43 dB
Hum modulation	Any channel less than or equal to 4%
Hum modulation at power frequencies	Any channel less than or equal to 3%
Cross modulation	Any channel greater than or equal to 53 dB
Composite triple beat	Any channel greater than or equal to 53 dB
Signal Leakage (Radiation)	
Frequencies less than or equal to 54 MHz	15 mV/meter measured 100 ft. from the system
Frequencies between 54 MHz and 216 MHz	20 mV/meter measured 10 ft. from the system
Frequencies greater than or equal to 216 MHz	15 mV/meter measured 100 ft. from the system

d. System Constraints

In most non-commercial DOD CATV systems, channel loading is usually light, limited to a few of the VHF frequencies. In systems of this type, perceived signal quality is most affected by: Signal Levels, Carrier to Noise, Hum Modulation, and to a lesser degree, by distortions like Cross Modulation and Composite Triple Beat. In more heavily loaded systems, Cross Modulation and Composite Triple

Beat become increasingly more important. This is because these distortions arise from the mixing of signals in the CATV system. As the number of signals increases, the distortion products also increase. Navy ships are in a unique position as they have a lightly loaded system when under way, but can have a heavily loaded system in port, if commercial CATV is available on the pier.

III. Testing Procedures.

Attachment 1 presents the approved methods for testing CATV systems to show performance conforming to the following standards. The National Cable Television Association (NCTA), the CATV industry association in the United States, have developed these procedures. The DoD has determined that these procedures reflect good engineering practice in the CATV industry, and has included them here with the NCTA's permission. Please note that the NCTA fully supports the following testing methods. It has chosen not to endorse any single set of absolute standards that are to be met. This is due to the wide range of types of systems in the United States, and the differing levels of standards that may be applicable. The standards presented are promulgated by DoD to define the minimum acceptable level of service for DoD CATV systems. Appendix 1 provides recording forms for system tests. These are reprinted with the permission of the Society of Cable Television Engineers.

Applicability of Tests

As noted above, different systems will need to place different emphasis on particular aspects of system performance. All systems must minimally monitor signal levels and signal leakage. Systems with light channel loading must also be concerned with carrier to noise and hum modulation. Systems with heavier channel loading must add composite triple beat and cross modulation to their areas of concern. If test equipment is not available, or alternate testing methods are desired, such as the use of automated test equipment, Detachments and networks should request variances within their chain of command.

Scheduling of Tests

Included here is a suggested timetable for testing. The schedule is for planned preventive maintenance. It is in addition to all demand maintenance requirements. Tests should be made at the system headend, and at, at least three locations in the distribution system, chosen to be representative of worst case expected service. Signal leakage must be monitored/checked through out the entire CATV system. Documented results of all testing should be maintained. This will allow for trend analysis, and will aid in transitioning.

As of 30 JUN 95 the FCC will allow the application of three additional standards for measurement of the performance of a cable system. These standards are set at the output of the modulating or processing equipment, which in most cases would be at the system head end.

Parameter	Requirement
Chrominance-luminance delay inequality chroma delay	Less than 179 nanoseconds
Differential gain	+/- 20%
Differential phase	+/- 10 degrees

The standards are:

Note: the FCC only requires testing demonstration this performance be completed every three years.

Parameter	Frequency		
	Continuously	Weekly or Monthly	Annually
Signal levels	X	X	X
Signal leakage	X	X	X
Carrier levels		X	X
Hum modulation		X	X
Carrier to Noise		X	X
Cross modulation		X	X
Composite T Beat		X	X

Digital Television

Many system operators are contemplating a mix of differing signal formats including NTSC, Encrypted NTSC, Digital, and HDTV on a single cable system. Although some assumptions are well accepted (e.g. digital signal will be able to be run acceptably at much lower max signal levels than NTSC) overall system performance may be affected by the overall channel loading/channel mix.

IV. Out of CONUS CATV

As noted earlier, Host Country regulations and requirements should be determined. The most stringent requirement shall take precedence.

V. Commercial CATV.

As noted earlier, Commercial CATV operators, serving DOD audiences in CONUS locations, may be subject to additional/different technical requirements promulgated by the FCC or Federal law. Readers are strongly encouraged to familiarize themselves with all local franchises/agreements concerning CATV at their location. They may then check through appropriate channels for guidance on federal policy and law.

